REMARKS

Claims 16-20 are pending in this application. By this Amendment, claims 16-20 are amended, and claims 1-15 are canceled. No new matter is added.

I. The Claimed Subject Matter

By this Amendment, independent claims 16 and 20 are amended to more clearly recite the method steps and structure for processing a substrate. More specifically, claim 16 is amended to recite:

> an initial film-forming step of forming an initial metal film on a substrate by executing once or a plurality of times, a source gas supplying step of suppling gas obtained by vaporizing an organic source to the substrate and allowing the organic source to be adsorbed on the substrate, and thereafter an excited-gas supplying step of supplying gas excited by plasma to the substrate, and causing the organic source adsorbed on the substrate to react with the gas excited by plasma, and forming a metal film on the substrate; and
>
> a main film-forming step of forming a main metal film being the same film as the initial metal film on the initial metal film by using a thermal CVD method, by simultaneously supplying the gas obtained by vaporizing the organic source and oxygen-containing gas or nitrogen-containing gas not excited by plasma,
>
> the initial film-forming step and the main film-forming step being performed in the same processing chamber and performed at the same processing temperature.

Claim 20 is amended similarly to claim 16.

The claimed subject matter is able to produce results not obtainable by the cited references.

In the source gas supplying step in the initial film-forming step, the gas obtained by vaporizing an organic source is supplied to the substrate, and the organic source is thereby adsorbed on the substrate. In the excited-gas supplying step, when the plasma excited oxygen is supplied to the substrate, the organic source adsorbed on the substrate decomposes and reacts with the plasma excited oxygen, thereby forming the initial film. In other words, an initial metal film is formed by using an ALD (atomic layered deposition) method.

In the claimed subject matter, the surface reaction is caused in such a way that the organic source reacts with the plasma-excited oxygen and is adsorbed on the substrate

surface. Thus, the initial metal film is formed without the need for generating incubation time. Accordingly, productivity of the semiconductor device having the metal film is improved with good step coverage (see, for example, paragraph [0096] of the U.S. Patent Publication of this application).

Further, in order to improve the step coverage in forming the metal film, the process temperature is reduced. However, because plasma-excited oxygen retains high reactivity even under low temperatures, the oxygen combines with elements such as carbon C, oxygen O, and hydrogen H contained as impurities in the organic liquid source. Thus, because the impurities react into gas, the impurities in the film are removed. In other words, the plasma-excited oxygen functions to facilitate the purification of the organic source adsorbed on the substrate and also functions to reduce the impurity level of the organic liquid source (such as C, O and H) captured into the film. Thus, a metal film having a good electric characteristic is obtained because impurities in the film are reduced. Further, because of the reduction of the impurities, the film formed by the excited-gas supplying step does not require a step of film quality improvement. Still further, because annealing can be performed for crystallization without film quality improvement after the film is formed, the film quality improving process can be omitted, thus improving the productivity of the overall process. Still further, film pealing that results from gas disorption of impurities does not easily occur even during annealing after film-formation, and a metal film having good adhesiveness is thus obtained (see, for example, paragraph [0097] of the U.S. Patent Publication of this application).

The initial metal film is formed in the initial film-forming step where the source gas supplying step and the excited-gas supplying step are executed once or repeated a plural number of times before forming the film by the thermal by the CVD method in the main film-forming step. Thus, no incubation time is required in either of the initial film-forming step or the main film-forming step. Specifically, in the initial film-forming step, the film is

formed by organic source adsorption and reaction with the plasma excited-gas (complete surface reaction), so no incubation time occurs. Because the main film-forming step uses the initial metal film as an underlying layer (forming the same film as the underlying layer), no incubation time occurs.

Further, in the main film-forming step, the ALD method is not used for forming the film. Instead, the thermal CVD method is used for forming the film. This contributes to an improvement in the deposition rate, thereby improving the productivity compared with a case of forming the metal film by repeating the steps of supplying organic source gas and supplying the plasma excited-gas as in the ALD method (see, for example, paragraph [0107] of the U.S. Patent Publication of this application).

When the initial film-forming step and the main film-forming step are performed in the same processing chamber and performed at the same temperature, the time required to raise and lower the operating temperature is unnecessary when shifting from the initial film-forming step to the main film-forming step. Thus, the overall productivity can be significantly improved.

Additionally, because the temperature is held the same in the processing chamber, the steps of the initial film formation and the main film formation can be continuously executed. Thus, the production cost can be reduced. Particularly, when the initial film-formation is performed at a temperature at which film formation is enabled by the thermal CVD method, the initial film-formation and the main film-formation can be performed at the same temperature. Thus, the efficiency of the production of the metal film can be significantly improved.

II. The Claims Are Patentable over the Applied References

The Office Action (1) rejects claims 1-11, 13 and 15-20 under 35 U.S.C. §102(e) over U.S. Patent Publication No. 2004/0018304 to Chung et al. (Chung); (2) rejects claim 12 under

35 U.S.C. §103(a) over Chung in view of U.S. Patent No. 6,617,248 to Yang; and (3) rejects claim 14 under 35 U.S.C. §103(a) over Chung in view of U.S. Patent Application Publication No. 2001/0024387 to Raaijmakers et al. (Raaijmakers). Applicants respectfully traverse the rejections of claims 16-20.

Chung discloses the disposition of a substrate within a chamber, activation of a gas remote from the chamber (paragraph [0035]), and pulsing the precursor into the chamber (paragraph [0040]). Further, an activated reducing gas which is activated remotely from the chamber may be provided to the chamber (paragraphs [0046] and [0047]). These steps are repeated (paragraph [0049]). The precursor and the reducing gas may be activated (paragraph [0050]).

Thus, regarding independent claims 16 and 20, Chung fails to disclose or suggest "an initial film-forming step of forming an initial metal film on a substrate by executing once or plurality of times, a source gas supplying step of supplying gas obtained by vaporizing an organic source to the substrate and allowing the organic source to be adsorbed on the substrate, and thereafter an excited-gas supplying step of supplying gas excited by plasma to the substrate, and causing an organic source adsorbed on the substrate to react with the gas excited by plasma, and forming a metal film on the substrate; and a main film-forming step of forming a main metal film being the same film as the initial metal film on the initial metal film by using a thermal CVD method, by simultaneously supplying the gas obtained by vaporizing the organic source and oxygen-containing gas or nitrogen-containing gas not excited by plasma, the initial film-forming step and the main film-forming step being performed in the same processing chamber and performed at the same processing temperature", as recited in claims 16 and 20.

For the foregoing reasons, Applicants request withdrawal of the rejections.

III. Conclusion

In view of the foregoing, it is respectfully submitted that this application is in condition for allowance. Favorable reconsideration and prompt allowance of the claims are earnestly solicited.

Should the Examiner believe that anything further would be desirable in order to place this application in even better condition for allowance, the Examiner is invited to contact the undersigned at the telephone number set forth below.

Respectfully submitted,

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JAO:JHB/mef

Attachment:
Petition for Extension of Time

Date: December 26, 2007

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